sandy soils, in assisting the capillary rise of subsoil water to the roots of plants. The part which humus plays in supplying water to crops is sufficient in itself for placing a high value upon the humus in soils.

Coming now more particularly to the chemical side of the question, it is important to note that humus as found in the soil always contains nitrogen, and that in its decay, acids are formed which combine with lime, potash and phosphoric acid, forming humates.

Practically all the nitrogen in soils is derived from the organic matter of natural vegetation or barnyard manure, and this, as has been stated, forms the humus; consequently, the amount of humus in a soil is an indication of the amount of nitrogen. Humus, as ordinarily obtained, contains from 3 to 10 per cent. of nitrogen, the amount depending upon the nature of the substance from which it was formed, its age, etc. Many good soils contain from 3 to 5 per cent. of humus, of which about one-tenth is nitrogen. Since, therefore, nitrogen is one of the most prominent constituents of humus, it can easily be seen that a loss in humus also results in a loss of nitrogen.

It is now well understood that the decomposition of organic matter is the result of the action of minute organisms. Cultivation opens up the soil and improves the conditions under which these organisms work, and thus hastens decomposition. The mineral matter combined with humus is rich in potash and phosphoric acid, two compounds which are of great agricultural value. In the case of rich prairie soils, over 1,500 pounds of phosphoric acid and 1,000 pounds of potash per acre to the depth of one foot have been found to be in combination with humus, while in soils poor in humus and worn by cropping, there may not be more than 100 pounds per acre. It is stated that the amount of phosphoric acid usually found associated with humus varies from 0.1 to 0.5 per cent. of the total amount in the soil, indicating in many cases the amount of this constituent available to plants.

It is not necessary to point out that loss of humus is always followed by a marked decline in productiveness. Every cultivator of the soil is familiar with that fact; nor is it necessary to discuss the various methods that may be followed to increase the humus content of the soil. Remember that land without a crop is subject to leaching, and that any crop, whatever it may be, grown to plow down will convert some of the inorganic constituents of the soil into organic combination and will form humus. Of course, no other crops will give so good results as the legumes, and just here let me state that it has been demonstrated that clover, roots and tops, three months old, will have gathered from the soil and atmosphere as much nitrogen as there will be in two crops of wheat. During the growth of the clover, potash and phosphoric acid will be brought up from the subsoil by the deep roots, and on the decay of the plant will be left in the surface of the soil. Further, in the decay of the clover, the physical condition of the soil will be improved, and the humic acid formed will aid in breaking up insoluble rock particles and combine with the constituents essential for the growth of crops. Nearly all our soils contain a large store of mineral plant food, which, in most cases, can be brought into an available condition by the combined use of humus and cultivation. In the absence or scarcity of the proper soil elements—like lime, potash, etc.—humus-forming material may produce sour lands, and lime particularly, and possibly phosphoric acid may be needed where humus is abundant, but in good soils, well stocked with lime, there is very little danger of this result.

In the above, some of the effects of humus on soils have been very briefly outlined. More might have been mentioned, but sufficient has been said to show clearly that humus is a very important constituent of the soil. It increases the water-holding capacity of the soil, it renders clays, more open and friable, and sands more compact, it supplies nitrogen, and it aids materially in rendering available the mineral constituents of the soil. If it does improve soils in all or in any of the ways above indicated, it is safe to conclude that, as a rule, soils will be benefited by those systems of culture which will conserve or increase their humus content.

As a result of these changes, generally known as "nitrification," humus is broken down, carbonic acid and various other acids are formed, and the nitrogen is converted into nitrates. These nitrates are soluble, and are caught by the water percolating down through the soil and carried away in the drainage water. Nitrification is one of the most important natural provisions for rendering the inert fertility of the soil available to plants, and a certain amount of it is necessary to plant growth, but it can easily be seen that under injudicious management or cultivation of the soil it may work a positive injury by causing unnecessary waste of the nitrogen; or, in case of rich soils, it may supply the growing crop with too much nitrogen, and thus produce a rank growth of straw and leaves. Moreover, it is also plain that unless organic matter is being continually added to the soil under cultivation, the amount of humus with all its beneficial effects and the amount of nitrogen must be gradually reduced.

Summer cultivation of all kinds greatly hasten nitrification. Consequently, bare summer fallowing will be very beneficial to the succeeding crop, by increasing the amount of available nitrogen, but frequently, if not always, more nitrogen is brought into a soluble form than is necessary for the crop, and whatever the crop is unable to utilize is lost by leaching; thus the available nitrogen is increased, while the total nitrogen is greatly decreased. Experiments have demonstrated that for every pound of nitrogen absorbed by a crop following the summer fallow, five pounds were lost in the drainage. (This applies more particularly in countries where the rainfall is heavier than in the west. Ed.) Summer fallowing is, therefore, only temporarily beneficial at the expense of the total humus and nitrogen of the soil. On the other hand, while summer cultivation of root and corn crops hastens decomposition in the same way as summer fallowing, the plant food rendered soluble is absorbed by the growing plant. It may also be noted that nitrification commences in the spring, as soon as the soil becomes warm enough, and that it is naturally most rapid near the surface, where there is plenty of air; consequently, with late spring plowing the available nitrogen is plowed down and inert organic nitrogen is brought to the surface.

Another point regarding the value of humus not generally understood, is that besides being a great reservoir of nitrogen, humus is an indirect means of supplying the plants with other fertilizing constituents. The mineral portion of soils is composed of more or less finely-divided rock particles, insoluble in water. These must be brought into a soluble condition before they can serve as food for plants. In the decay of organic matter, carbon dioxide is liberated and aids materially in the decomposition of these insoluble substances. Various acids, known collectively as humic acids, are also formed, and these aid in this decomposition and combine with the lime, potash, phosphoric acid, iron, etc., and form the humates.

The Food of Plants.

A continuous supply of all the essential elements of plant growth is absolutely necessary, for it has been fully demonstrated that in order to produce normally-developed plants each and all of the nutrients required must be present. If one constituent is present in insufficient quantity, no matter what amount of the other nutrients is available, the plant cannot be fully developed; consequently, just as a chain is only as strong as its weakest link, so the crop-producing soil is limited by the essential nutrient present in relatively the smallest quantity. When a mere neutralization of acids is involved, potash or lime may be replaced by soda, or when incrustations of a tissue is necessary for protection, the place of calcium carbonate may be taken by silica. But in the purely physiological functions of a chemical nature, not even a partial substitution is possible.

Fortunately, of the ten essential plant nutrients only four are likely to be present in insufficient quantities, and are, therefore, the only ones requiring special attention. These are nitrogen, potassium, phosphorus and calcium. Chemically considered, these are the substances we estimate in determining the fertility of soils, the value of farmyard manure and of fertilizers.

In the absence of nitrogen, a plant makes no appreciable growth. With only a limited supply, a plant begins its growth in a normal way, but as soon as the available nitrogen is used up, the lower and smaller leaves begin gradually to die down from the tips, and all the plant's energy is centred in one or two leaves. Nitrogen is one of the main constituents of proteids, which are present in all plants. It is also a constituent of chlorophyll, the green-coloring matter of plants, hence with a limited supply of nitrogen the leaves will have a sickly yellow color. Plants with large, well-developed leaves, of a rich green color, are not suffering for nitrogen. An over-abundance of this substance may, however, produce a very rank growth of leaf and stem, and retard the maturity of the seed. Therefore, when crops, such as the cereals, tomatoes, potatoes, etc., are to be matured, an over-supply of nitrogen may be injurious, but with crops such as mangels, cabbage, etc, which are harvested in the green condition, an abundance of nitrogen will insure a large, strong growth. It is hardly necessary to point out here that the nitrogen is most economically supplied by the growing and plowing down of leguminous crops.

Phosphorus, in the form of phosphates, is found in all parts of the plant, but tends to accumulate in the upper part of the stem and leaves, and particularly in the seed. Its function is to aid in the production and transformation of the protein bodies. The nuclei are said to be the manufacturers of the protein matter, and phosphorus is essential for the full action of the nuclei. The phosphoric acid is said to "follow the proteids," and it seems to be so essential for protein production that the yield of grain is much more increased by phosphoric acid than by nitrogen and potassium compounds. An insufficient supply of phosphoric acid is always followed by the production of a poor yield of shrunken grain; or, in the case of sugar beets, by a comparatively low percentage of sugar. Nitrogen forces the leaf and stem growth, and the presence of phosphoric acid is needed to hasten maturity. So strong is the action of phosphorus in this direction, that at maturity about three-quarters of the total amount of this constituent taken up by the plants is found in the seed. Potassium is one of the most important and least variable of all the elements in the ash of plants. It is quite evenly distributed throughout the growing plant, and generally occurs in the entire plant in the largest proportion of any of the essential ash constituents. It is taken up in the early stages of plant growth, and is always present where the production of plant tissue occurs. The function of potassium is apparently to aid in the production and transformation of the carbohydrates. Potassium also appears essential for the formation of protein, and thus indirectly aids in the formation of all organic matter. It doubtless has much to do in regulating the acidity of the sap, by forming salts with the organic acids developed during the growth of the plant.

Calcium is a constituent of the straw rather than the grain, and seems to impart hardiness to crops. It has long been noticed that soils containing an abundance of lime usually produce well-nourished crops that are more capable of withstanding unfavorable climatic conditions, as drouth and early frosts, than are crops not so well supplied with lime The exact function of lime is not clearly understood, but it does seem to aid in the construction of the cell walls. According to some authorities, its absence is felt in less time than either potassium or phosphorus. It is claimed that a supply of lime is just as essential to the plant, in order that it may form cell walls from starch and sugar, as it is for the formation of bone in animals.

There can be little doubt that a proper balance in the supply of these important plant nutrients has a decided influence on the nature of the crop produced. Each one has its own particular work to do, and the absence or deficiency of any one of them will cause the death or the incomplete development of the plant. Added to the fact that these substances are absolutely essential, we find that they are absorbed during the early stages of growth, and that with cereals this gathering period is a very short one. It is thus plain that, struggle as it may, a plant cannot make a normal development and mature its seed unless it has a full supply of a well-balanced diet placed within its reach.

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Alberta's Weed Inspector.

The Province of Alberta has recently added to the ranks of its agricultural experts a strong man of sterling worth in the person of Arch. Mitchell, late of the Dominion Department of Forestry. Mr. Mitchell has accepted the position of Provincial Weed Inspector. His previous work has given him a wide knowledge of agricultural conditions, and he has always been a keen student of affairs. He is a well known Institute worker, having spoken all over the West on such topics as: farm forestry, soil cultivation, weeds and how to destroy them. Mr. Mitchell is an enthusiast in any work he undertakes. Honest, conscientious and thorough he is not only a worker but a patriot. He works because he has an abiding faith; he believes in the future of western agriculture and gives of all his strength to help the cause along. The problems he has to face are many and difficult; we bespeak for him the hearty co-operation of our readers. Long life and success to the new Provincial Weed Inspector!

Creative Work.

He was sitting in an easy chair in a comfortable office and I said to him: "Happy man, what a fine time you have, a good job and not much to do!" But man is not a creature easily satisfied. Slowly he blew the rings of smoke from his pipe and looked out across the fields to where the men were busy with the seeding, and said: "From the bottom of my heart I envy those men; they at least, are doing something of creative work. At night they leave behind them the mark of something done. I even envy the man who sweeps the office building. Every stroke of his broom leaves a clean spot."

Therein lies the secret of a life worth living. It rests in the joy of doing something. It is the spur that stimulates effort in every line of life. No rich man with his store is as happy as the toiler, who with his own hands has created something definite as the product of this day's work. Are you doing that in the West to-day? Are you leaving behind you as a mark of your existence, something tangible, something of real worth, something you have done?

Prairie Fires.

Every spring the fire fiend finds in the open prairies of the far West a wide scope for his work of destruction. A match, a cigar, or a cigarette in the hands of a careless smoker, or a spark from a passing locomotive, and in a few minutes a tongue of flame springs into being and